Climate Change Trends for Planning at Allegheny Portage Railroad National Historic Site, Pennsylvania

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Historical Trends

From 1901 to 2002, mean annual temperature increased across North America (Figure 1; Gonzalez et al. 2010) and showed a statistically significant increase in the area that includes Allegheny Portage Railroad National Historic Site (NHS) (Figure 2, Table 1). From 1901 to 2002, precipitation increased across most of North America (Figure 3; Gonzalez et al. 2010), including the area that includes Allegheny Portage Railroad NHS (Figure 4, Table 1), although the Allegheny trend was not statistically significant. Analyses of causal factors attribute 20th century warming and precipitation changes to greenhouse gas emissions from vehicles, power plants, deforestation, and other human activities (Intergovernmental Panel on Climate Change (IPCC) 2007, Bonfils et al. 2008).

Future Projections

The Intergovernmental Panel on Climate Change (IPCC) has coordinated research groups to project possible future climates under defined greenhouse gas emissions scenarios (IPCC 2007). The three main IPCC greenhouse gas emissions scenarios are B1 (lower emissions), A1B (medium emissions), and A2 (higher emissions). Actual global emissions are on a path above IPCC emissions scenario A2 (Friedlingstein et al. 2010).

For the three main IPCC emissions scenarios, projected 21st century temperature in the Allegheny Portage area could increase five to nine times the amount of historical 20th century warming (Table 1, Mitchell and Jones 2005, Gonzalez et al. 2010). General circulation models (GCMs) of the atmosphere project increased annual precipitation in the Allegheny Portage area under all three emissions scenarios (Table 1, Mitchell and Jones 2005, Gonzalez et al. 2010). For emissions scenario A2, the average projected change in annual precipitation is 7 ± 6%, with 15 out of 18 GCMs projecting increases in precipitation (Figure 5; historical average from Mitchell and Jones 2005, Hijmans et al. 2005; projections from IPCC 2007, Tabor and Williams 2010, Conservation International; analysis by P. Gonzalez).

References

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Table 1. Historical and projected climate (mean ± standard deviation (SD)) trends for the area that includes Allegheny Portage Railroad NHS (Mitchell and Jones 2005, IPCC 2007, Gonzalez et al. 2010). Climate projections for IPCC emissions scenarios B1 and A1B are calculated at 50 km spatial resolution (Gonzalez et al. 2010) and, for emissions scenario A2, at 4 km spatial resolution (data from Conservation International using method of Tabor and Williams (2010)). Note "century^{-1}" is the fractional change per century, so that +0.03 century^{-1} is an increase of 3% in a century.

	mean	SD	units
Historical			
temperature 1901-2002 annual average	9.6	0.7	ºC
temperature 1901-2002 linear trend	+0.5	2.4	ºC century^{-1}
precipitation 1901-2002 annual average	1060	120	mm y^{-1}
precipitation 1901-2002 linear trend	+0.03	0.38	century^{-1}
Projected			
IPCC B1 scenario (lower emissions)			
temperature 1990-2100 annual average	2.7	0.9	ºC century^{-1}
precipitation 1990-2100 annual average	0.06	0.06	century^{-1}
IPCC A1B scenario (medium emissions)			
temperature 1990-2100 annual average	3.9	0.9	ºC century^{-1}
precipitation 1990-2100 annual average	0.06	0.06	century^{-1}
IPCC A2 scenario (higher emissions)			
temperature 1990-2100 annual average	4.5	0.9	ºC century^{-1}
precipitation 1990-2100 annual average	+0.07	0.06	century^{-1}

Figure 1.

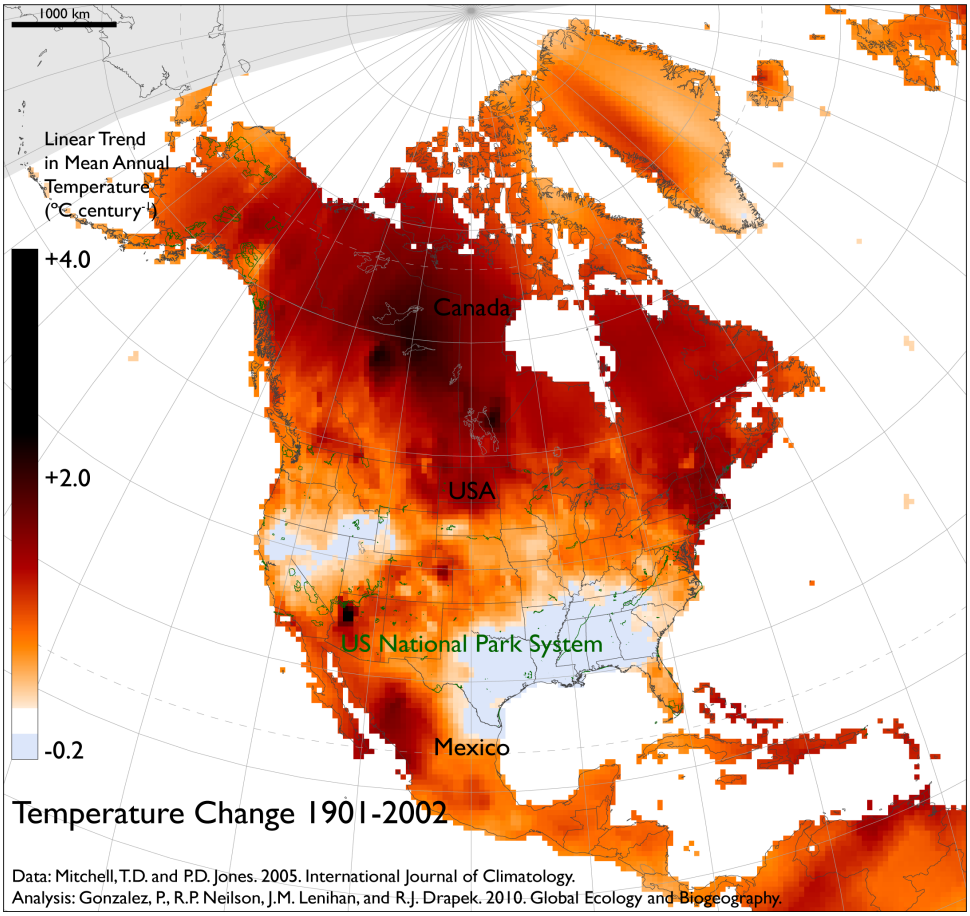


Figure 2.

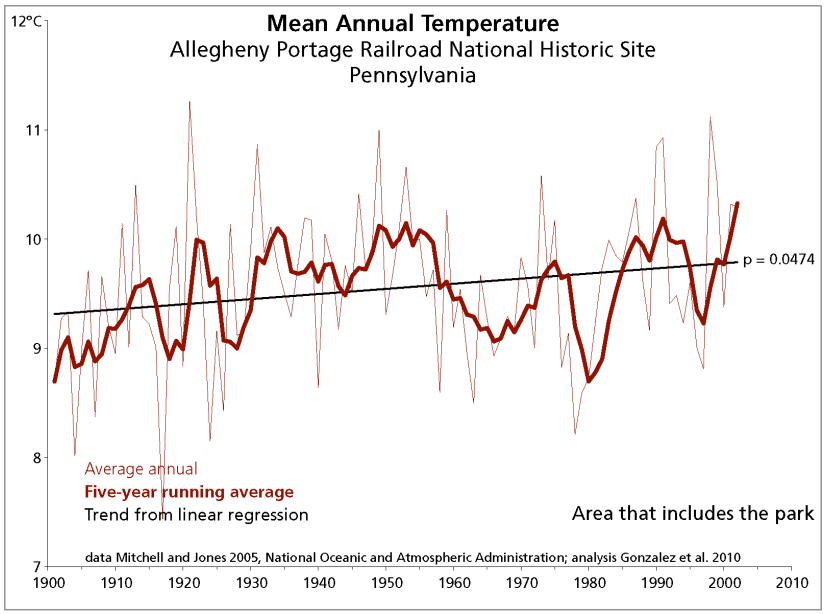


Figure 3.

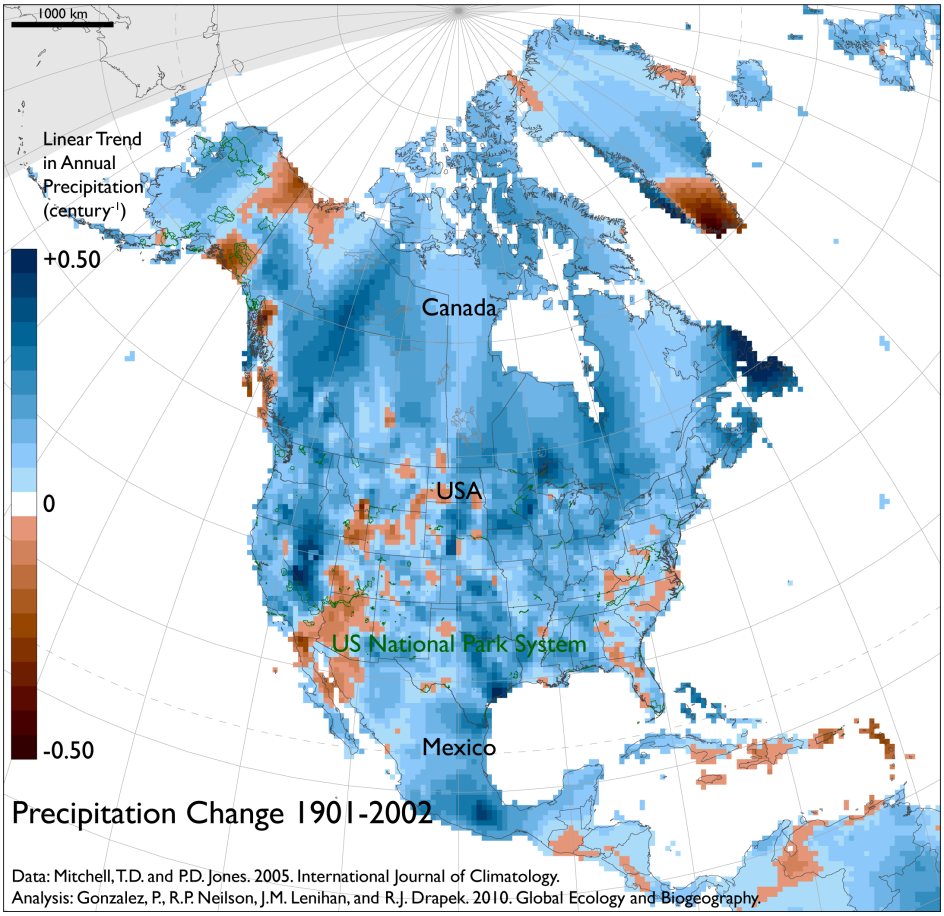


Figure 4.

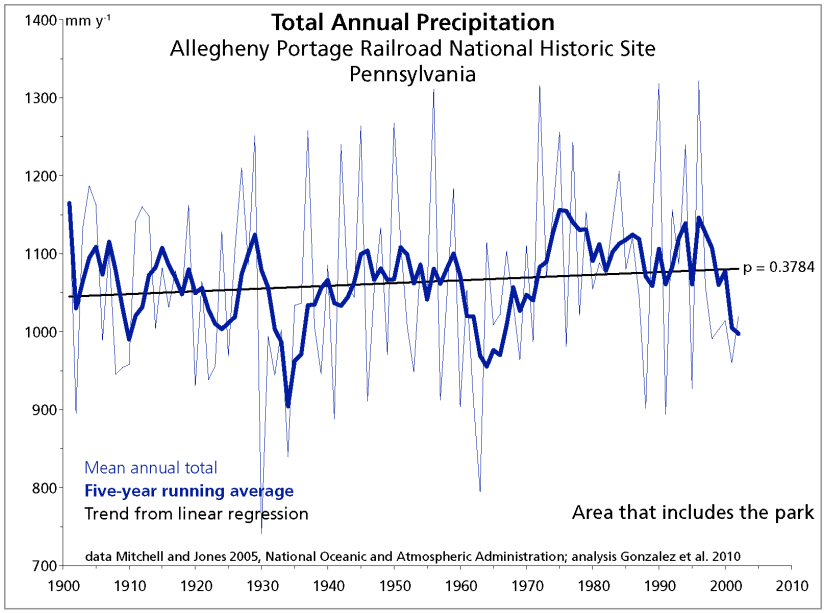
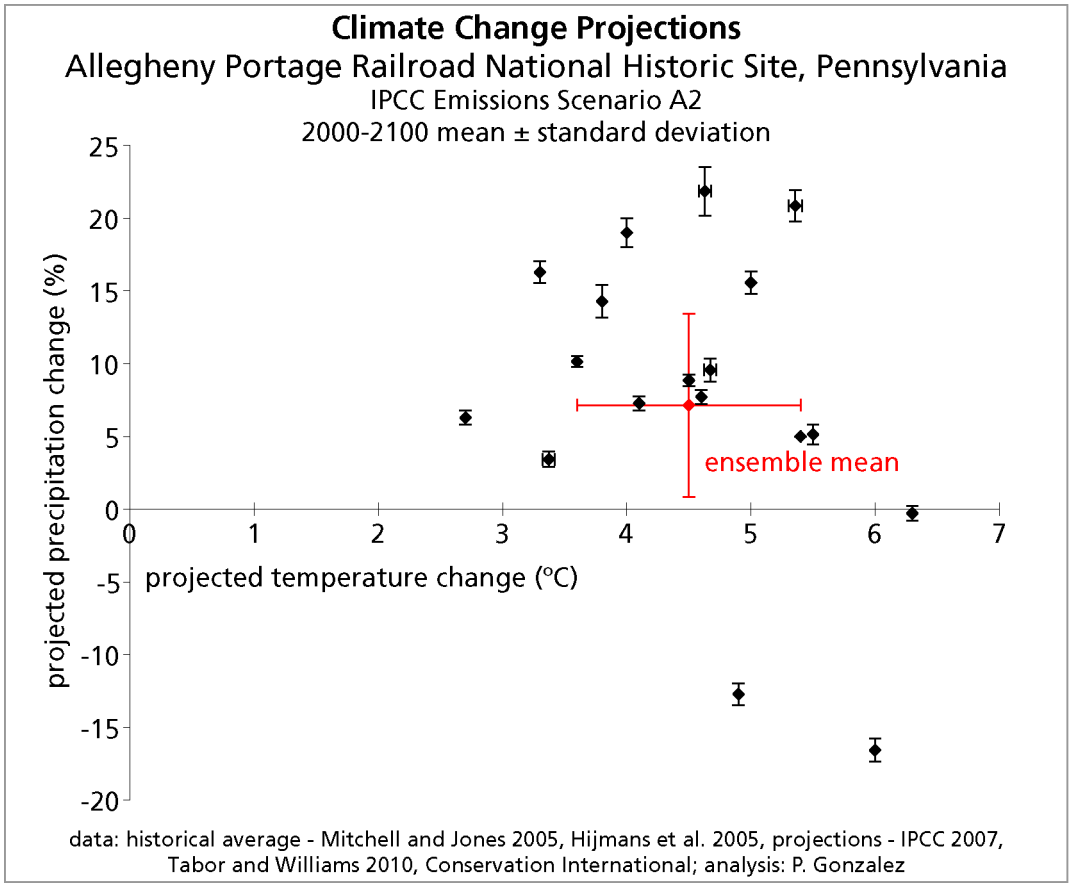


Figure 5.


Climate Change Projections
Allegheny Portage Railroad National Historic Site, Pennsylvania
IPCC Emissions Scenario A2
2000-2100 mean ± standard deviation
projected precipitation change (%)
projected temperature change (°C)
ensemble mean
25
20
15
10
5
0
-5
-10
-15
-20
0
1
2
3
4
5
6
7
data: historical average - Mitchell and Jones 2005, Hijmans et al. 2005, projections - IPCC 2007,
Tabor and Williams 2010, Conservation International; analysis: P. Gonzalez